IMPROVEMENTS

Still wanted in England relative to mettallurgy, and the sciences of mines.

WITH A GLANCE

How to reap the benefit of the richness of the mineral Kingdom both of the mother country, and its colonies, hitherto neglected.

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NAPLES

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FEW WORDS

ON THE PRESENT PUBLICATION.

The civilities I experienced in England from the gentlemen, to whom I was recommended; and the knowledges relating industry, and the useful sciences I am indebted to that country, afford me the opportunity of testifying my gratitude to that illustrious nation.

In order to reach my object, I think it is worth while to develop some ideas about a branch of industry, which has not as yet been carried to its perfection on that side of the water. I mean the working of mines, and metallurgy; the reason of which will appear hereafter.

This being my purpose, I am confident it will not be taken for criticism the ingenuity, I express in the following remarks for the wealth of a nation, which deserves the admiration of the world, and to which I am peculiarly devoted.

The author.

I.

Improvements still wanted in England about metallurgy, and the sciences of mines.

During my tour through England I wrote these remarks, and I could not help being very much surprised of the bad state of the mines, as well of the processes of tin, lead, and copper melting houses, which I saw in Cornwall, Derbyshire, Northumberland, and in the other counties of England, Scotland, and Ireland.

England, whose superiority on all kinds of industry, and above every other part of the world is demonstrated by a numerous quantity of valuable products of her manufactories, and especially by the wonderful extension of trade; England, said I, presents a very pitiful picture of metallurgy, and of the sciences concerning the mines: so that when a travaller goes from Hungary, or Saxony to that island, is without doubt induced to think that this country is two, or three centuries back to Germany.

The richness of the ores of english mines, is the cause of this disproportion. And in deed the tin and copper veins of S. Austle, S. Agnes, S. Just, Penzance, Nordowns, Redrouth, Illogan, Cambron etc. in Cornwall show but a heap of pure ores, their breadth having several feet, without the smallest part

of rubbish-stone; so that they have nothing to do, but cut these ores, and melt them into metal. The vary same happens to the lead mines of Winster, Castleton, Eayam, Aschower in Derbyshire; of Alstonmoor, Neanthead, Allenheads, Cowshills etc. in Northumberland; of Dufton and Appleby in Westmoreland; of Leadhills, Wanlockhead, Strontian in Scotland etc.

This being the nature of english mines, we may find the reason why they have neglected in England the sciences of mines; as the subterraneous geometry, metallurgy, and the mechanical processes, concerning the concentration of metallic ores: since industry arises from poverty.

In order to have an idea of what I have just mentioned, it must be known no maps, drawings, or plans, performed by help of trigonometry and the compass, are to be seen at the english mines; either to perform the excavations from one point to another, through the shortest way, for saving expences; or to open a communication betwéen a subterraneous point and the light, and promote thus the ventilation of the mines; or to let down a pit upon the extremity of a level, as well for bringing out the ores, they have met with, as for the establishment of hydraulic engines into it, and dry up the water that infests the mines; or to reach a vein alréady known in a certain distant part of a mountain; or to excavate a level by different and

opposite points at once with exactness on its direction, and upon a determined declivity on its basis for the conveyance of the water etc. etc.

These and alike other problems, belonging to subterraneous geometry, are quite omitted, and even ignored in England, since they have no other object on their works, but to follow always the veins, they have once accidentally discovered. But very great inconveniences arise from this procéeding, because when obliged, by some accident, to work through the sterile rock, they have no guide; their works are irregular; more extensive than they ought to be, and proportionally expensive. An instance of the incredible expences, they undergo in England from the omission of the subterraneous geometry, (without which there is no possibility to carry on such works with exactness and economy), is to be verified at the tin and copper mines of Cornwall, where an astonishing quantity of fire engines, burning each from four to six guineas of pit coals daily, are employed to raise the water from the bottom of the mines. Were the subterraneous geometry practised there; had they thought to join all the mines of a district with a level, carried on the deepest part of the country, through the shortest way, and with a declivity proportional to its lenght, and to the depth wanted (what supposes the most exact practice of the subterraneous geometry) the waters of all those mines colle-

cted in this level, could have been dishcarged out by this way : they should have spared so many engines, as well expensive on their construction, as in their support : and they would have daily occasion of discovering new veins and ores, which remain yet occult. Those, who have seen the mines of Hungary with attention, will easily understand my meaning.

Moréover the richness of english metallic ores afford no occasion of seeing in that island the valuable establishments for their concenration ; which whilst from one side put into trade a very great quantity of metals, contained in their matrices, and which in default of such establishments remain useless and quite lost ; from an other they present an exstensive branch of subsistence to the lowest class of the inhabitants of the country. In this latter respect the mines containing a scanty quantity of metal, so that there it will be the necessity of washing, and bruising the matrices into an impalpable powder, for the concentration of metallic particles, are to be considered as very precious for every country. Now such mines are quite unnoticed in England. It is very agréeable and surprising to take a view of the establishments, they have for the silver, gold, and lead mines at Schemnitz, Kremnitz, Kapnik, and Nagybania in Hungary ; for the copper mines at Herrengrund and Schmölnitz in the same country ; for the copper mines at Orawicza, Saska, Moldowa, and Dognaska in Bannat ; for the silver mines

at Freyberg, Gersdorf, Marienberg, Iohangeorgenstadt in Saxony; for the tin and silver mines of Joachimsthal, Abertam, Platten, Schlaggenwald, Zinnwald, Schönfeld in Bohemia; for the silver and copper mines at Andreasberg, Clausthal, Zillerthal, Zellerfeld, and Goslar in Hartz etc. etc. An astonishing number of oldmen, women, and children, who should remain without any employement in these countries, find their subsistence at the several works, they have there for the concentration of metallic ores; so that many towns, willages, and boroughs could not exist ou such wild and sterile mountains, had they neglected the mines of a very scarce metallic contents, as they do in England. Now Cornwall, Derbyshire, Northumberland, and the other counties of Great Britain, where mines abound, might give a very commodious subsistence, and for many centuries to several hundred thousand of individuals, if they would but think how to introduce, and improve the mechanical establishments for the concentration of the ores, I have just mentioned.

Farther if we examine the english tin, copper, and lead melting houses, we shall meet with the very same disproportion, as to be not satisfied with the processes they employ in that country for the separation of such metals from their matrices. The reverberatory furnaces they have adopted in England, for the employement of pitcoals, do not at all answer to this purpose. As the compound

of the ores results from a composition of a stony or earthy, metallic, and of inflammable substances, it fallows that their separation is only due to their specific gravity, when melted, and put in a state of liquidity by the help of fire. But in order the specific gravity might operate this separation, it is required a certain depth in the construction of the furnaces, by means of which the most ponderous particles, namely the metallic, will precipitate themselves to the bottom of the furnaces, forming the regulus, whilst the lightest, as the earthy are, will float upon them, originating slaggs. When this happens, as there does not exist any affinity between the metallic and earthy substances of the ores (and this for their being of an heterogeneous nature), they part mutually one from the other, and it is in this manner that the aforesaid separation takes its origin. From an other side fire volatilizes the inflammable particles. Hence the parallelepipedic form of the furnaces is the most adapted for the separation of metals from their matrices. Now the reverberatory furnaces having no depth, and being of a quite flat construction, there is wanted in them the necessary depth for the separation of the regulus from the slaggs. We see, therefore, in the english furnaces of that Kind, that when ores are melted, the metallic and earthy liquid extends itself upon the flat ground of them; the metallic and earthy substance remain a long time mixed

together ; whilst from one side the metallic particles , alréady reduced , cause , by means of burning , a loss to the mass , and from the other the slaggs , fault of a compléte separation, retain a very great part of the metallic substances. Thus they have a double loss. The first is always increasing , seeing they are obliged to melt again (in order to part metals as far as possible from slaggs) for a second , third , fourth and for many times more the mass. Notwithstanding these reiterated fusions , the slaggs remain always very much impregnated with metallic particles , so that they are very heavy and compact, instead of being light , spungy , and brittle, as the requisites of slaggs ought to be, since slaggs are but the earthy particles put into fusion by fire. The tin melting houses at Truro in Cornwall ; of the copper reverberatory fournaces at Hayle near S. Yves ; those of Swansea, Bristol , Liverpool , Hecton etc. present daily an instance of the imperfection of this branch of metallurgy. I saw in Hayle, and in Swansea that they were obliged to melt from 12 to 20 times the very same mass , for drowing out the copper from their ores. They have , also , very considerable losses , occasioned by the burning of their copper. I observed every where a very astonishing quantity of heavy and compact slaggs neglected , and even thrown in the sea, as it happens at Neath. They could daily load many ships with them ; besides the slaggs , with which

they build very strong walls, and which I was not able to break into pieces with a strong hammer, what is an argument of their metallic contents.

I take now the opportunity of making here two observations, the first of which will confirm still more the improvements yet wanted in England about metallurgy; and the latter will shew how many resources they might obtain from such a great quantity of slaggs, I have just mentioned, and which lay neglected in the aforesaid places, what will prove farther the wanting of a reasonable practice, concerning the separation of metals from their ores and matrices.

As for the first observation it is Known, that besides the parallelepipedic form of the furnaces, which should be animated always by engines, economy requires also two conditions on the ores, submitted to fusion.

The first concerns the nature of their matrices; the second their metallic contents.

The simple earths are quite refractories, or not fusibles at all, when singly taken. However they acquire several degrées of fusibility, according to their being mixed together in a great or less number, and at different proportions. Thus, for instance, the siliceous earth is not to be melted when alone; but it is brought into fusion (giving a mass between porcelain and enamel, glazed and semitrasparent) when mixed with equal parts of calcareous earth, in a heat not under 150

degrées of Wedgwood's pyrometer. The same siliceous earth is easier melted, when mixed with two other earths in a certain proportion, as for instance 54 parts silex, 36 argill, and 10 calx melt in a frothy semitrasparent enamel at 136 degrées of the same pyrometer. The very same happens to the other earths. Thus 3 parts of argill, 2 calx, and 1 silex give, when exposed to fire, a green glass: 3 calx, 3 argill, 2 silex give a porous enamel: 1 magnesia, 3 calx, 3 argill, 2 silex give a porous porcelain mass etc. etc. Hence it fallows there should be committed a very great fault in metallurgy, when melted ores of an homogeneous nature, considered their matrices; namely siliceous ores are not only to be mixed with others of calcareous and argillaceous temper, but a certain proportion is to be observed between them, according to the experiments alréady Known concerning their fusibility, and this to avoid not only the consummation of coals, but to prevent also the burning of the metal, which they contain.

The second condition prohibits the fusion of the ores singly taken, that is to say as well those on which metal abounds, as those which are to poor in their metallic contents. The reason is because in the first case there should be burnt a great quantity of metallic particles, and in the second an exceeding quantity of coals, whilst a great part of their metal should pass into the slaggs.

Therefore rich ores are to be tempered with poor ones, so that it might arise a compound of a middle containing, for saving thus the combustibles and the metal. For this purpose each class of ores is submitted to a docimastic essay on its coming from the mines, or from the above mentioned establishments of concentration, as it is practised in Germany; after which they mix together the poor with the rich; those of calcareous nature with others having silex, or argill in their matrices, and it is in this manner they combine a whole answering to the two conditions, I have before explained.

Now contrary to what I have just exposed, I have very often seen at Swansea in Glamorganshire, at Hayle, Bristol etc. that they melt once calcareous copper ores singly taken, an other time argillaceous, a third time siliceous ones. Moreover these ores were sometimes of the richest, and at others of a very low contents. It is also easily to be perceived that thus they must burn a great quantity more of coals, as it is wanted, and that the metallic losses ought increase (as well for the metal burnt, as for the metallic particles remained in the slaggs) in a very surprising manner. The hardness, and the exceeding weight of such slaggs, as I experienced many times on my being there, will give a satisfactory argument of the bad methode they employ in England for the fusion of their ores, which ought to be improved.

The second observation concerns precisely the very surprising advantages they could draw in England from such slaggs, which for several centuries have been heaped up in the neighbourhood of the melting houses, and which lay quite lost. In order to establish the idea of what I am now saying, it is to be Known they collect in Hungary, as in Schemnitz, Altgebürg, Tajowa etc. the slaggs thrown away by the ancients, and which being melted again, not only pay fully the expences, but give also to the undertakers a very valuable benefit. Notwithstanding such slaggs are not half so rich as the english, because although the ancients, by fault of knowledges about chemistry, had not brought the processes of their foundries to that perfection, which we observe now on the Hungarian melting houses, yet as they did melt their ores with furnaces answering somewhat to the separation of metallic from earthy particles, the slaggs they cast off are proved to be of a very tolerable quality. And in deed those slaggs are spungy, light, and brittle. Neverthless they contain from 4 to 7 per ct of copper; whereas those they obtain in our days in Hungary do not exceed $\frac{1}{2}$ per ct, and even such slaggs are melted again with fresh ores, to which they are added rather as a dissolving ingredient, or flux, for vitrifying their matrices. The omission of this ingredient (for they never add in England the slaggs of a former fusion) is a new argument

of the imperfection of this branch of metallurgy in that famous country. The ordinary method they employ in Hungary for the fusion of the slaggs (after their being excavated from a depth of several feet , to which since many centuries lay burried by stream water , and after their being washed and cleaned out from the earth , by which they are involved) is to melt them singly , or alone in a crooked furnace (*Krummofen*) ; with charcoals. By these means they obtain a kind of regulus, containing from 60 to 75 per ct of copper, called there black copper (*Schwarz-Kupfer*), which is afterwards refined in a reverberatory furnace (*Spleissofen*), and moreover a small quantity of metallic stone (*Leech*) lying upon the regulus , of the contents about 25 per ct, which when collected in a sufficient quantity , is previously calcinated, and then melted again with the above mentioned slaggs , and thus they always proceed.

It would bo then very profitable to introduce in England the crooked , or rather the high furnaces (*Hochöfen*) together with the blowing engines , not only for a better fusion of copper, tin , and lead ores , but also for taking an advantage from such a great quantity of slaggs, thrown away in that island.

I could evince , where I to insist farther upon this argument, that England might have a benefit , or an increase of 40 per 100

at least upon the actual products of her mines, did they but think not only how to improve their melting houses, but provide also for a better economy of their subterraneous works, and besides avail themselves of the aforesaid establishments for the concentration of metallic ores. What economy concerns, I mean the extension, they could give to the mines, by opening the veins, which considered their richness are really great deal inferior to those, they usually cut out, and which want a mechanical concentration, before their fusion; I mean the exercise of the subterraneous geometry, in order to open and convey the pits and levels with certitude and exactness; I mean the bringing out as well of the ores, as of the sterile rock through the shortest way; I mean the contrivance of collecting the internal waters of several mines together, in order to let them out through a common and deep level, and spare thus many fire engines, which they employ for this purpose; I mean a deposit of the most rich ores, which they should keep always ready and untouched as a reserve in time of want; that is to say when the veins become sterile and insufficient to pay the expences, and when it is necessary to explore, with new pits and levels, the mountains adjoined to the mines, and thus open fresh veins etc.

II.

A glance how to reap the benefit of the richness of the mineral Kingdom both of the mother country, and its colonies, hitherto neglected.

In order to remove all the inconveniences, I have just mentioned, and promote in the most eminent degrée the wealth, which may arise from mineral Kingdom as well of England, as of her colonies yet neglected, it would be necessary to establish (as they have done at Freyberg in Saxony, at Schemnitz in Hungary, at Clausthal in Hartz etc.) in a county of England, where mines abound, an academy or school, where as well the sciences concerning the mines, namely, chemistry, mineralogy, docimasy, metallurgy, mechanic, and subterraneous geometry, as likewise the practice of these sciences ought to be taught. The best place would be Truro, or Redruth in Cornwall, since the great nomber of copper and tin mines, the melting houses, and the fire engines they have in the neighbouring places, would afford a most extensive instruction to the apprentices, who should study there, and be then appointed as directors of the works. In this school ought to be adjoined a compléte collection of fossils, a cabinet of models and plans of the engines, furnaces, and other objects, concerning the

mines and metallurgy. Morćover a laboratory for essaying the different ores by the dry and moisty way; a library, and drawing rooms, fit for the performance of maps and plans belonging to subterraneous geometry, together with the necessary instruments for such purposes. Téachers of the above mentioned sciences should be choosen and charged with the compilation of elementary works for their pupils; and considering the english language possesses but very few books upon these matters, the translation of the best german writers ought to be highly recommanded. The scholars ought twice, or three times in a every week take a view of the mines, foundries, and engines etc., draw the plans of them, and especially exercise themselves with the problems and other operations of subterraneous geometry, whilst from an other side they ought to become dexterous in the practice of essaying the mineral substances. After three, or four years of such a study, they should make a tour through the mines of Derbyshire, Northumberland, Westmoreland, and of the other counties, and then they ought to be appointed for the direction just mentioned. I tink, even, necessary to send from time to time two or three of the most advanced among these pupills (as the other nations do) to Freyberg and Schemnitz in Germany, where the great extension and the variety of the works, would render them very proficient and fit in promoting the

wealth of their own country in the mineral and metallurgical way.

Besides they ought not delay to carry into execution in England the mechanical establishments for saving so many metallic matrices, which remain now neglected, namely the *bruising veins* (*Pochgänge* of the Germans) which are duly to be submitted to the concentration. Therefore they should construct in the neighbourhood of the mines (as in S. Agnes, Redrouth, S. Just, S. Austle, etc.) some bruising engines (*Pochwerke*), the meals of which (*Mehl*) ought to be concentrated (*Geschlemt*) to the washing Works (*Schlemherde*), they should adjoin to them, and have thus the sands (*Schliche*) fit for the fusion. These bruising and washingworks could be introduced, by degrées, in Derbyshire, Northumberland, Cumberland, etc. for the concentration of lead bruising veins, yet neglected. However since such establishments require a great quantity of water, they should think also on the means how to collect it in convenient places, by performing artificial lakes and canals for its derivation to the works. It is only in this manner they draw the greatest benefits in Saxony, Bohemia, Hartz, Hungary, Transilvania, Carniola etc. from so many silver, copper, lead, tin, gold, and quicksilver bruising veins, which otherwise would remain of no use and entirely abandoned, as it does now happen in England. I think besides it

would be very suitable to such undertakings to call in England some workmen from those countries, in order to instruct the natives in the practice of the works of that kind.

At length melting high furnaces, with blowing engines, would answer much better, than the reverberatory furnaces, they have at present in England. It is true that the crooked or high furnaces (*Krumm, oder hochöfen*) want charcoals for the best fusion of the ores, since the reduction of metallic particles is operated but by the carbonic principle, of which the charcoals abound, whereas the pitcoals contain a small quantity of it. Notwithstanding I saw at Rothenburg in Prussia the fusion of copper ores into high furnaces carried perfectly on with pit and charcoals mixed together. At Cessy not far from Lion in France, they employ also the pitcoals for the fusion of their copper ores. Considering that they melt every where, in England, the iron ores with pitcoals into high furnaces, and blowing engines (as in Carronworks in Scotland, in Neath, Rotheram, Coalbrookdale, Birmingham, Marthyr etc.) I am of opinion that the copper, lead, and tin ores would answer our best expectation, if treated into crooked or high furnaces with blowing engines and pitcoals. Nevertheless they should be previously converted into coaks, as they ordinarly do for the iron ores, and this not only to purify them from the tar and pitch they contain, but to volatilise

also the brimstone, which would give otherwise origin to the sulfuric acid, by which the metallic particles would be corroded, and dissolved with very considerable loss.

These are the chief objects, which deserve the utmost attention of the undertakers of the mines in England, and which include also several other branchs no less interesting. These are a better Keeping of the mines (*Die Gruben Unterhaltung*) in respect of their fortification (*Gruben Zimmerung*), of the subterraneous ventilation (*Wetter Wechsel*), and of the extraction as well of the ores, as of the rubbish stones (*Bergförderniss*); the washing and sortiment of the matrices and ores *Waschen und Scheiden*) and their separation by the help of the sieve (*Siebsetzen*); the choice of the planes for the concentration (*Die Schlemmherde*) either the Hungarians (*Hungarische Schlemmherde*), or the Knocking planes (*Stossherde*) as they chiefly use in the Land of Salzburg; the choice of the dissolvents (*Flüsse*), which are to be mixed with the ores, according to their nature; the selectness of the processes for the fusion of the ores (*Rösten und Schmelzen*) for the precipitation of the metal, they contain (*Niederschlag*), and for the farther refinement of the regulus obtained (*Spleissen, Treiben, und Gaarmachen*).

I am now going to point out with few words what must be done, in order that

England should derive the greatest advantages from the richness of the mineral Kingdom of her colonies, yet ignored and neglected.

It is a very surprising thing, when we read the accounts of many travellers through the english establishments in the East-Indias. At every step they mention silver specimens, gold dust, copper, tin, quicksilver, and iron ores found at different places. However England has not yet a single establishment in that part of the World, for availing herself of so great many treasuries. They ignore, even, the spring places, from whence so many ores, specimens, and gold dust, torn from their veins, are carried here and there by the rivers and other waters. I say nothing of the darkness, which fully involves the geological branch of the english possessions, and which should be removed, would they make rapid strides in this way.

Experience has taught the miners what are the mountains, that conceal the metallic veins and ores. Thus sienit porphyr gives aboundantly gold, silver, lead, and copper, as we verify in the *Saxum metalliferum* of Schemnitz, Kremnitz, etc. in Hungary. Gneis furnishes the same metals, as it happens in Saxony. Wacke give lead, silver, copper, and iron as in Hartz. The argillaceous slate (*Thonschiefer*) lead and silver, as in the West part of Saxony, in Bohemia, in Hartz, Cornwall etc. The micaceous slate (*Glimmerschiefer*) is very rich in iron veins, as

seldom and very few metals, as tin in Schlaggenwald, and iron in Irrgang in Bohemia. Serpentin is quite empty of metals, excepted some native copper, which is found in it in Cornwall. Quartz is also not favourable to metallic veins, as they are too gips, clay, green stone, porphyr slate, (*Porphirschiefer*), basalt, trapp, and all volcanic mountains.

According this experience the perfecte Knowledge of the nature of all the mountains of english establishments must be considered as the first step, proper to lead to the discovery of the metallic veins and ores, I am mentioning. This Knowledge will enable the searchers of these precious objects to pay a peculiar attention, and practise the convenient operations precisely to the mountains, which deserve to be investigated, and omit those, which considered their nature afford no reason of being explored.

Experienced men, then, well acquainted with mineralogy, geology, chemistry, docimasy and, if possible, with the sciences concerning the mines, ought to be appointed and sent by governement in the english possessions, to travell the interior part of them. They should be charged with the commission not only of examinating the different countries, but of describing also the geological part of their hills, mountains, plains, and walleys. They should, for the best success of this undertaking, perform distinet maps of

every country, designing with different colours the various rocks, which form the grounds, the mountains, and the other parts of their inquiry. They ought, also, collect and send to England a complete collection of specimens of all the stones, or rocks (*Gebürgsarten*) composing the mountains, and grounds mentioned, with refering their description to the coloured maps. On metallic veins and ores being discovered, after having chosen several specimens of them, namely the richest, those on which metal is but scarcely experienced, and especially those, which copiously abound, they should distinctly mark on the maps the places, where they occur. Capital veins (*Gänge*) ought to be brought, with the help of trigonometry and compass, on the maps, showing the direction they have towards the cardinal points of the world (*Streichen*); expressing their breadth (*Mächtigkeit*), and, if possible, their inclination (*Verflechung*) upon the horizontal line of the globe. Moreover their descriptions should contain the nature as well of the ores, as of their matrices. Above all docimastic essays ought to be performed, in order to Know the metallic contents. Those of the commissioners, who are acquainted with the sciences of the mines ought give a distinct plan about the works, necessary for the undertaking of the mines intended; namely the excavation of the pits and levels, their depth, length, direction, inclination,

and dimensions; their distance from the veins and ores; the best performation of the levels for carrying out the subterraneous water; the engines wanted not only for the extraction of the ores and rubbish stones, but also for raising the water of the mines, when levels are not to be practised for this purpose; the indication of the places, where the works; and the melting houses for the reduction of the ores into metal, could be established, and this considered the combustibles wanted, as well for the calcinations, as for the fusion, and considered the water necessary for the engines; the distance of such places from the mines; the nature of the roads; the summary of the expences for carrying on into execution their plans; and at length the demonstrative view of the benefits, which can arise from the undertaking. All such objects, till now mentioned, as rockstones (*Gebürgsarten*), ores, geological maps, drawings, descriptions, and plans ought to be sent to England, duplicates of them all, and by two different conveyances, in order that a collection of such objects may arrive there, should the other be lost.

According the idea, I have given of this undertaking, they ought adjoin to the British museum in London several rooms for the exposition of the colonial mineralogical productions; but not as objects of curiosity, as generally they do in England, but for the wealth of the nation, that is to say for the

instruction of the public, and for the guide of the speculators.

The colonial collection of fossils, ought then be divided in three classes. The first ought to be a geological one, containing the various stones, by which the mountains are composed, or the primeval, stratified, alluvial, and volcanic substances. The second should be a systematical, or orictognostical collection, presenting the genera and species of the fossils found in the english possessions. The third should exhibit an economical collection, comprehendig the fossils in the english dominions, employed in the different arts and manufactories, as enameling, colouring, daying, pottery, glazing, sculpture, architecture, jowellery, agriculture, polishing, furnacebuilding, medicine; besides the ores of the various metals. The descriptions mentioned should be published, and permissions granted for the undertaking of such mines. Companies could promote the convenient works, and the governement ought not fail to enter (and this for the best success of the business) in partnership with them, as the Emperor of Austria, and the other Germans Sovereigns do.

Considered the very great extension of the english colonies, 20 or 30 of such commissioners should be, perhaps, not sufficient for their exploration, during a time of five, or six years. Pupils ought even to be adjoined to them, for the farther continuation and

ampliation of this great and profitable undertaking. Let the governement employ a sum of money for this expedition, yet who does not perceive the expences will soon be followed by the most unexpected benefits? A single happy discovery will be, without doubt, able to increase, in an astonishing manner, the wealth of an industrious nation, as England is, and render her still farther the mistress of the world.

THE END.